**Homework Assignment #4 (Logic)**

**1** Write truth tables for the following logic expressions:

    **a.** $\neg\neg p$

    **b.** $\neg(\neg p \wedge q)$

    **c.** $p \Rightarrow (q \vee \neg r)$

**2** For each of the following propositions, express it as a logic expressions. You should introduce lower case letters to represent the simple propositions, and use appropriate logic operators such as $\neg, \wedge, \vee, \Rightarrow \iff$ to connect them. Afterwards, write the truth table for the expressions.

    **a.** You will get better in writing if you keep practice.

    **b.** You will get better in writing only if you keep practice.

**c.** Either it's too hot, or it's too cold. (Note, obviously, it's not both too hot and too cold).

**d.** To grasp someone's mathematics background, it is sufficient to have them pronounce the name "Euler".

**e.** You are legally driving in Pennysylvania only if you are 16 years old.

**3** Prove that the following two logic expressions are logically equivalent: $p \wedge (q \vee r)$, and $(p \wedge q) \vee (p \wedge r)$.

**4** Are the follwoing propostiions tautology or contradiction? Explain your answer.

(a) $p \wedge (p \Rightarrow q) \wedge \neg q$

(b) $\neg (p \wedge q) \vee (p \wedge q)$

**5** Recall the Smullyann islanders (a fictional island named after logician Raymond Smullyan), who either are truth-tellers who always tell the truth, or liars who always lie. Suppose you meet two islanders, A and B. A says, "we are same kind of islanders", and B says "We are different kinds of islands". Same kind means both are truth-tellers or both are liars, and different kinds means one is truth-teller and another is liar.